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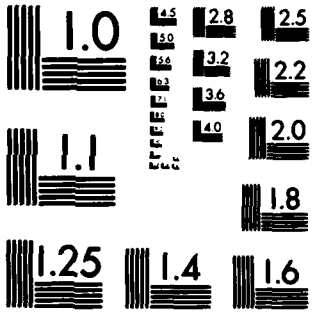

INVESTIGATION OF THE MBE GROWTH OF InSb AND NOVEL QUANTUM WELL STRUCTURES

(12)

R.F.C. Farrow

Progress Report for the
Period October 1983 to March 1984
ONR Contract N0014-83-C-0617

April 27, 1984

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1. Objectives

The prime objectives of this contract are twofold: (a) the preparation and characterization of InSb/CdTe interfaces to investigate the existence of a two dimensional electron gas confined in the InSb by the interface potential; (b) the preparation and characterization of InSb films grown onto lattice-matched CdTe substrates.

2. Progress Report, October 1983 — March 1984

In this period, the reproducible preparation of high purity, high perfection CdTe films on ion-cleaned InSb substrates and on InSb buffer layers on InSb substrates has been achieved. The techniques of cross-section transmission electron microscopy (XTEM), double crystal X-ray rocking curve analysis (DCRC), $He^{(+)}$ ion channeling, photoluminescence, far infrared magneto-absorption and C-V profiling have been used to study the CdTe film and interface properties.

The C-V studies (Figure 1) have confirmed that the undoped CdTe films are n-type with carrier concentrations in the 10^{14}-10^{15} cm^{-3} range. The background carrier concentration N_B is 8×10^{14} cm^{-3} for the example in Figure 1. The interfaces are free of misfit dislocations (Figures 2, 3). Photoluminescence studies carried out by Dr. John Furneaux at NRL confirm the high purity of the films and absence of deep level

recombination centers in the CdTe films grown at temperatures below 200°C. Preliminary magneto-absorption studies carried out by Dr. Bob Wagner at NRL have revealed 1s-2p transitions from donors in the CdTe. No evidence of an InSb inversion layer was found in the case of InSb-CdTe interfaces prepared by ion cleaning. However, SIMS studies have revealed significant interdiffusion for these interfaces which could[1] quench the inversion layer. CdTe-InSb buffer layer interfaces have been prepared and SIMS studies show these to be much sharper than the ion-cleaned interfaces. Samples of these structures have been forwarded to NRL for magneto-absorption studies. In parallel with these investigations, a series of MBE-grown CdTe-InSb samples have been forwarded to Dr. B. D. McCombe (SUNY at Buffalo) for infrared magneto-optical investigations.

MBE growth of InSb films on CdTe have recently been prepared and are under investigation.

Reference

1. P. Migliorato and A. M. White, Solid State Electronics, 26 (1), 65 (1983).

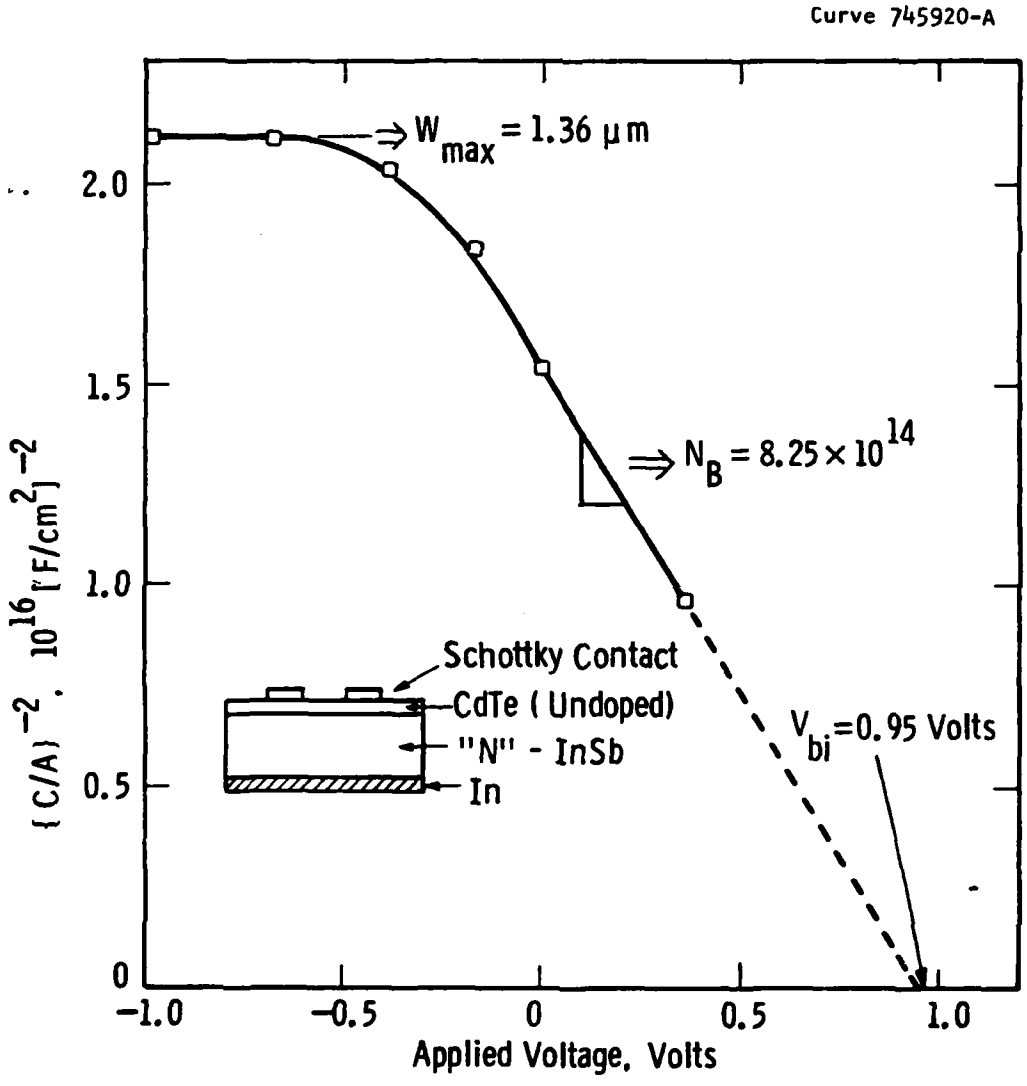

Figure 1. Capacitance-voltage plot for an undoped CdTe film grown on (001) InSb at 200°C.

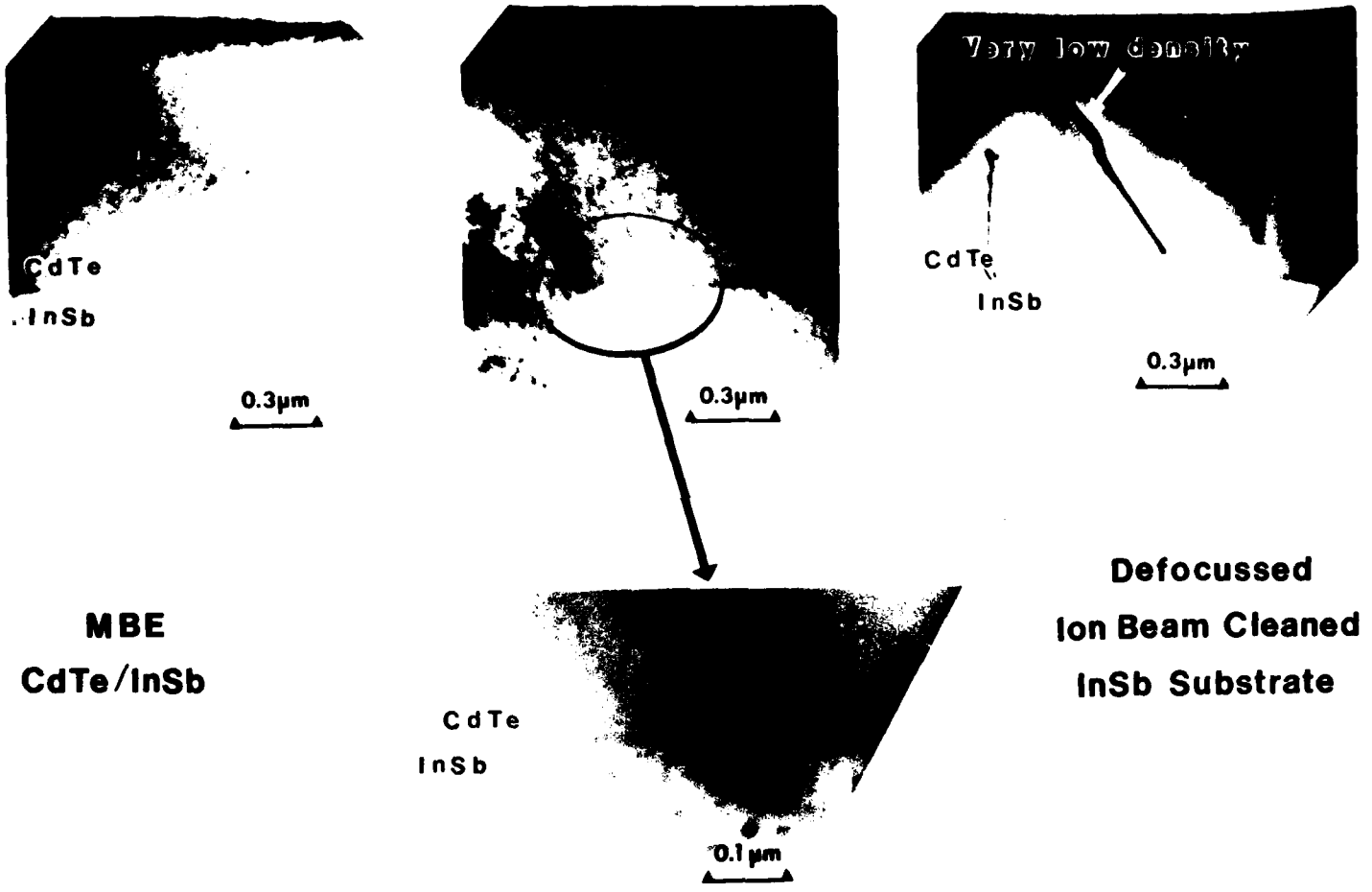

Figure 2. Cross-sectional transmission electron micrographs for high-perfection CdTe film, 1 μm thick, grown at 200°C on InSb (001) surface prepared by argon ion bombardment and annealing. Few extended defects were present and virtually no misfit dislocations.

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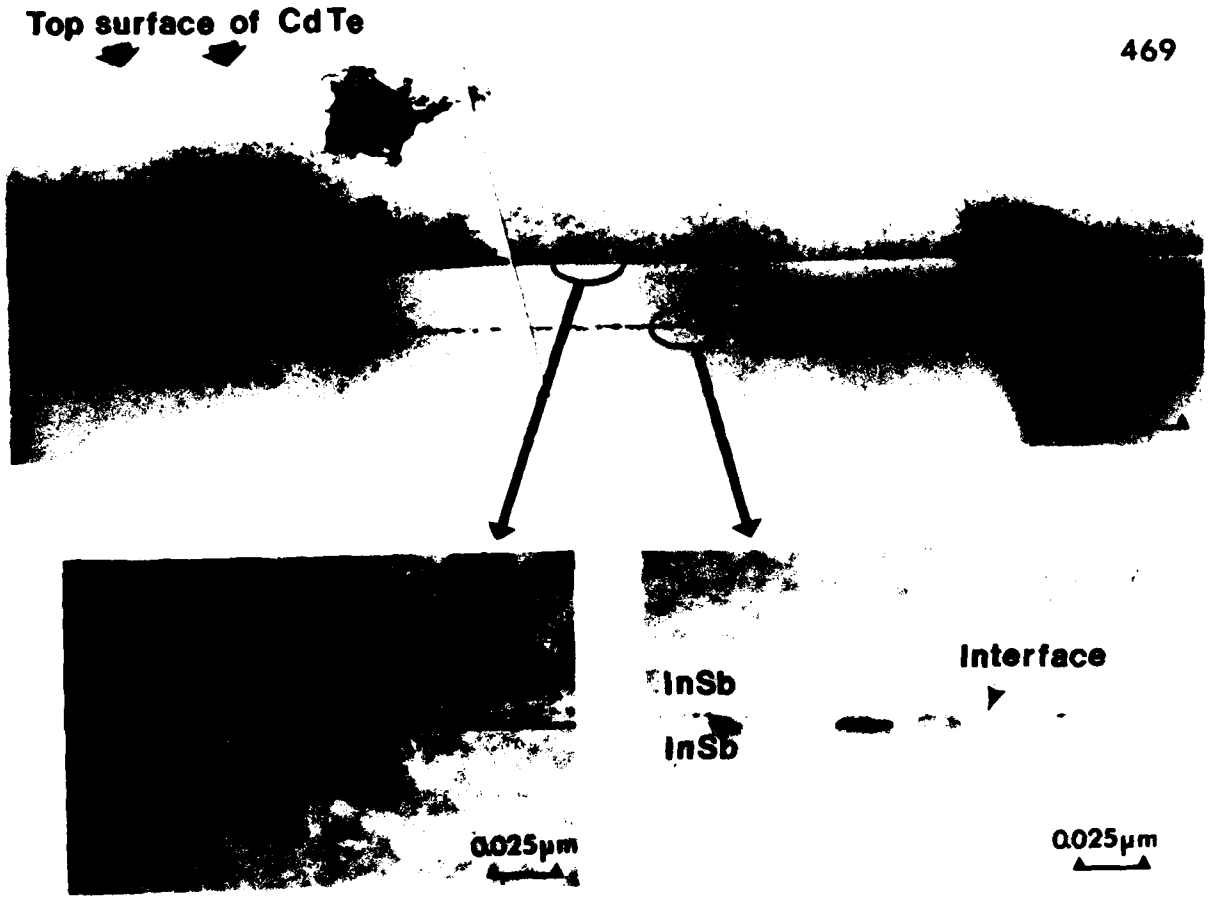

Figure 3. BF XTEM micrographs of a good-quality CdTe film grown on a thin (0.2 μm) InSb buffer layer. The CdTe/InSb interface is clean, whereas the InSb/InSb interface is defined by residual surface contamination and In-rich precipitates.


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